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(71)Applicant : TOYOTA MOTOR CORP

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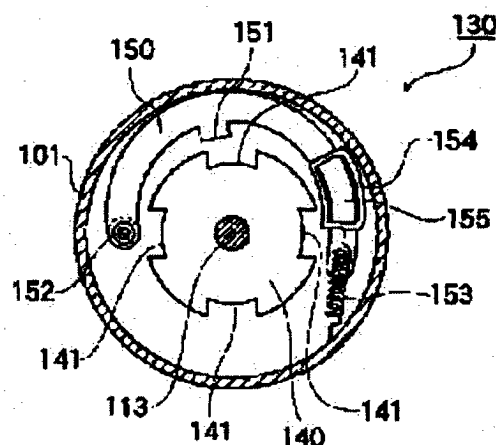
(72)Inventor : KOSHIRO TAKAHIRO
KAWAMURO JIYUNJI
MATSUDA MORIHIRO
NAKATSU CHIKATOSHI

(54) STEERING CONTROL DEVICE FOR VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To surely operate a lock mechanism of a transmission ratio varying mechanism by changing a transmission ratio between an input shaft-an output shaft by rotary driving of a motor, performing an operation control for the motor together with an operation control of a driving means and controlling locking of a tilting member and a rotating member and releasing of the locking.

SOLUTION: A lock arm 150 is normally energized so as to be tilted to a lock holder 140 side with a supporting pin 152 as a center by an action of a spring 153, a state that an engagement projecting part 151 of the lock arm 150 enters into an engagement recessed part 141 of the lock holder 140 is made, the lock holder 140 and the lock arm 150 are locked each other and a lock state is made. When an electromagnetic coil 154 is energized, repulsive force is generated between the coil 154 and a metallic plate 155, the lock arm 150 is tilted so as to be away from the lock holder 140, and the engagement projecting part 151 of the lock arm 150 is moved to the outside of the engagement recessed part 141 of the lock holder 140 and locking of the lock holder 140 and the lock arm 150 is released.



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CLAIMS

[Claim(s)]

[Claim 1] The steering control unit for vehicles which is characterized by providing the following and which performs steering control of vehicles. A transfer-ratio adjustable means to have the output shaft connected with an input-shaft [which is connected with a steering handle side], and ***** side, and to change the transfer ratio between input-shaft-output shafts by the rotation drive of a motor. A rotation position detection means to detect the rotation position of the aforementioned motor. tilting supported free [tilting] to the stator side which constitutes the aforementioned motor -- a member Lock control means it is fixed to the driving means to which the aforementioned tilting member is made to tilt, and Rota which constitutes the aforementioned motor, carry out the motion control of a motor with the aforementioned tilting member, the rotation member which has the section which can be stopped, and which can be stopped at intervals of predetermined, and the motion control of the aforementioned driving means, and control a stop with the aforementioned tilting member and a rotation member, and stop release.

[Claim 2] the aforementioned lock control means -- the aforementioned tilting member -- rotation -- a member -- the aforementioned rotation detected by the tilting control means which make the aforementioned driving means drive, and the aforementioned rotation position detection means so that it may tilt to a side -- the steering control unit [equipped with the rotation position of a member, and the rotation drive motor-control / motor / aforementioned] means based on a position error with the aforementioned section which can be stopped / according to claim 1 for vehicles

[Claim 3] the aforementioned lock control means -- the aforementioned tilting member -- rotation -- a member -- the steering control unit for vehicles according to claim 1 equipped with the tilting control means which make the aforementioned driving means drive, and the motor control means which carries out the rotation drive of the aforementioned motor at least more than the formation interval of the aforementioned section which can be stopped so that it may tilt to a side

[Claim 4] The aforementioned lock control means are steering control units for vehicles according to claim 3 which it has further in a failure judging means judge it as what failure generated in the lock mechanism by the aforementioned tilting member and the rotation member when the rotation of the aforementioned motor obtained based on the detection result of the aforementioned rotation position detection means becomes more than the formation interval of the aforementioned section which can be stopped.

[Claim 5] The aforementioned lock control means are steering control units for vehicles according to claim 1 equipped with the tilting control means which make the aforementioned driving means drive, and a motor control means to make the aforementioned motor reciprocate in the predetermined range so that the aforementioned tilting member may estrange from the aforementioned rotation member.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the steering control unit for vehicles equipped with the transfer-ratio adjustable mechanism.

[0002]

[Description of the Prior Art] The steering control unit which carried from the former the transfer-ratio adjustable mechanism in which the transfer ratio between the steering angle of a steering handle and ***** of ***** was changed is known. For example, the steering control unit which equipped JP, 11-34894, A with the lock mechanism which locks the differential mechanism in such a transfer-ratio adjustable mechanism is indicated. This lock mechanism is the mechanism in which the heights of the lock arm fixed to the motor housing side are stopped, to the crevice of the body of revolution fixed to the motor axis of rotation of a transfer-ratio adjustable mechanism.

[0003]

[Problem(s) to be Solved by the Invention] Thus, since a lock mechanism was a mechanism with which a crevice and heights are made to engage, the physical relationship of the crevice of body of revolution and the heights of a lock arm was not in agreement, at the time of a lock, there may be no lock from skillful ****, and there was a case where there was no lock release in skillful ****, by the bite lump by the lock arm and body of revolution at it at the time of lock release.

[0004] this invention is made that such a technical problem should be solved, and the purpose is in offering the steering control unit for vehicles which may operate the lock mechanism of a transfer-ratio adjustable mechanism certainly.

[0005]

[Means for Solving the Problem] Then, the steering control unit for vehicles concerning a claim 1 A transfer-ratio adjustable means to be the steering control unit for vehicles which performs steering control of vehicles, to have the output shaft connected with an input-shaft [which is connected with a steering handle side], and ***** side, and to change the transfer ratio between input-shaft-output shafts by the rotation drive of a motor, A rotation position detection means to detect the rotation position of a motor, and the tilting member supported free [tilting] to the stator side which constitutes a motor, The driving means to which a tilting member is made to tilt, and the rotation member which is fixed to Rota which constitutes a motor and has the section in which a tilting member and a stop are possible, and which can be stopped at intervals of predetermined, Motion control of a motor is performed with the motion control of driving means, and the lock control means which control a stop with a tilting member and a rotation member and stop release are had and constituted.

[0006] Although the lock and lock release of a differential mechanism in a transfer-ratio adjustable means are made by a stop with a tilting member and a rotation member, and stop release, in addition to the motion control of driving means, lock control means perform motion control of a motor in this case. thereby -- the time of a lock -- rotation -- when it becomes possible to certainly make in agreement the physical relationship of the section of a member which can be stopped, and a tilting member and the bite

lump has arisen between the tilting member and the rotation member at the time of lock release, control of which this bite lump is canceled in operating a motor can be carried out

[0007] lock control means [in / a claim 1 / in the steering control unit for vehicles concerning a claim 2] -- a tilting member -- rotation -- a member -- the rotation detected by the tilting control means which make driving means drive so that it may tilt to a side, and the rotation position detection means -- the rotation position of a member and the rotation drive motor control / motor / means based on a position error with the section which can be stopped are had and constituted

[0008] tilting control means -- a tilting member -- rotation -- a member -- a rotation member is rotated by the motor control means to the section which can be stopped based on the position error which got mixed up with this control and was detected at the same time it makes it tilt in a side, i.e., the lock direction. Thereby, a rotation member and a tilting member can be stopped certainly.

[0009] lock control means [in / a claim 1 / in the steering control unit for vehicles concerning a claim 3] -- a tilting member -- rotation -- a member -- the tilting control means which make driving means drive, and the motor control means which carries out the rotation drive of the motor at least more than the formation interval of the section which can be stopped are had and constituted so that it may tilt to a side

[0010] rotating a rotation member at least by the motor control means more than the formation interval of the section which can be stopped, after making a tilting member tilt in the lock direction by tilting control means -- rotation -- since the section of a member which can be stopped serves as the situation of surely passing through the position which faces a tilting member, a rotation member and a tilting member can be stopped certainly

[0011] When the rotation of the motor by which the lock control means in a claim 3 are obtained based on the detection result of a rotation position detection means becomes more than the formation interval of the section which can be stopped, the steering control unit for vehicles concerning a claim 4 equips further the lock mechanism by the tilting member and the rotation member with a failure judging means judge it as what failure generated, and constitutes.

[0012] Although rotation of a motor will stop if a rotation member stops with a tilting member, when failure occurs in a lock mechanism, a tilting member and a rotation member do not stop mutually, but a motor continues rotation more than the formation interval of the section which can be stopped. This situation is judged by the failure judging means.

[0013] The steering control unit for vehicles concerning a claim 5 equips with and constitutes the tilting control means which make driving means drive, and a motor control means to make a motor reciprocate in the predetermined range so that a tilting member may estrange [the lock control means in a claim 1] from a rotation member.

[0014] Although a tilting member is made to tilt by tilting control means at the time of lock release so that it may estrange from a rotation member, a motor is made to reciprocate in the predetermined range by the motor control means at the time of this control processing. thereby -- a tilting member -- receiving -- rotation -- it will be in the state where the section of a member which can be stopped displaces in vibration, and it acts so that the bite lump between a tilting member and a rotation member may be canceled by this movement

[0015]

[Embodiments of the Invention] Hereafter, with reference to an accompanying drawing, it explains about the operation gestalt of this invention.

[0016] The composition of the steering control unit which equipped drawing 1 with the transfer-ratio adjustable mechanism concerning the 1st operation gestalt is shown.

[0017] The transfer-ratio adjustable mechanism 100 has the input shaft 20 connected with the steering handle 10 side, and the output shaft 40 connected with Wheel FW side, and has formed the steering angle sensor 60 which detects steering angle θ of the steering handle 10 to the input shaft 20. Moreover, the output shaft 40 is connected with the rack shaft 51 through the gear equipment 50 of a rack-and-pinion formula, and Wheel FW is connected with the both sides of the rack shaft 51.

[0018] The transfer-ratio adjustable mechanism 100 is expanded and is roughly shown in drawing 2.

The transfer-ratio adjustable mechanism 100 is equipped with the motor 110, the reducer 120, and the lock mechanism 130, and has the function to change the transfer ratio of the rotation between the input-shaft 20-output shafts 40.

[0019] A motor 110 is equipped with the angle-of-rotation sensor 102 (refer to drawing 1) which detects angle-of-rotation θ_{tam} of a motor, and constitutes the servo motor which can control a rotation position while it is equipped with the stator 111 fixed in the motor housing 101, and Rota 112 supported free [rotation in the motor housing 101].

[0020] The reducer 120 constitutes the epicyclic gear mechanism and is fixing the sun gear 121 located in a core to the axis of rotation 113 rotated in one with Rota 112. Moreover, to it, the planetary gear 122 which revolves the circumference of a sun gear 121 around the sun is arranged at equal intervals, rotating around a sun gear 121, and each planetary gear 122 is supported free [rotation] with the carrier 123 connected with the input shaft 20. The starter ring 124 formed in the inner skin of the motor housing 101 is allotted, and the motor housing 101 is connected with an output shaft 40, and is constituted so that each planetary gear 122 may furthermore be surrounded.

[0021] Moreover, the part shown by the A-A line between a motor 110 and a reducer 120 is equipped with the lock mechanism 130 which locks the differential mechanism of a transfer-ratio adjustable mechanism. This lock mechanism 130 equips with and constitutes the lock electrode holder 140 of a disk configuration, and the lock arm 150 which curved circularly, as shown in drawing 3 .

[0022] It is fixed to the axis of rotation 113 which penetrates a core, and the lock electrode holder 140 rotates the lock electrode holder 140, the axis of rotation 113, and Rota 112 in one. Moreover, the engagement crevice 141 is formed in the periphery section of the lock electrode holder 140 at the predetermined intervals.

[0023] On the other hand, the lock arm 150 projects and forms in the lock electrode-holder 140 side the engagement heights 151 engaged in the engagement crevice 141 of the lock electrode holder 140. moreover, the end face section of the lock arm 150 is supported free [tilting] centering on the support pin 152 by the support pin 152 fixed to the motor housing 101 -- having -- **** -- the point of the lock arm 150 -- electromagnetism -- a coil 154 -- having -- this electromagnetism -- the metal plate (magnet board) 155 fixed to the position which faces a coil 154 at the motor housing 101 side is arranged. Furthermore, the other end of the spring 153 which fixed the end to the motor housing 101 is being fixed to the point of the lock arm 150.

[0024] Thus, as the lock arm 150 is always energized by the operation of a spring 153 so that it may tilt to the lock electrode-holder 140 side centering on the support pin 152, and it is shown in drawing 3 , it will be in the state where the engagement heights 151 of the lock arm 150 enter in the engagement crevice 141 of the lock electrode holder 140, the lock electrode holder 140 and the lock arm 150 of each other are stopped, and, thereby, relative rotation with the motor housing 101 and Rota 112 is prevented. For this reason, the operation of the adjustable mechanism of a transfer ratio becomes impossible, and the transfer-ratio adjustable mechanism 100 will be in a lock state.

[0025] on the other hand -- electromagnetism -- if energized by the coil 154 -- between metal plates 155 -- electromagnetism -- as shown in drawing 4 , repulsive force [-like] occurs, the lock arm 150 is tilted so that it may estrange from the lock electrode holder 140, the engagement heights 151 of the lock arm 150 move out of the engagement crevice 141 of the lock electrode holder 140, and a stop with the lock electrode holder 140 and the lock arm 150 is canceled by the operation. This will be in the state which the motor housing 101 and Rota 112 can relative rotate, and the transfer-ratio adjustable mechanism 100 is the mechanism canceled of a lock state.

[0026] If the angle of rotation of an output shaft 40 is set to output angle θ_{tap} here, since the relation of steering angle θ_{tah} , angle-of-rotation θ_{tam} of a motor 110, and output angle θ_{tap} will turn into a relation shown by (1) formula and the relation of steering angle θ_{tah} , output angle θ_{tap} , and a transfer ratio G will be prescribed by (2) formulas, (3) formulas can show angle-of-rotation θ_{tam} of a motor 110 from (1) formula and (2) formulas. In addition, "K" in a formula is the reduction gear ratio of a reducer 120.

[0027]

$\text{thetap} = \text{thetah} + K \cdot \text{thetam}$ -- (1)

$\text{thetap} = G \cdot \text{thetah}$ -- (2)

$\text{thetam} = (G - 1) \cdot \text{thetah} / K$ -- (3)

Therefore, transfer-ratio control between the input-shaft 20-output shafts 40 can be performed by controlling angle-of-rotation thetam of a motor 110 according to steering angle thetah based on (3) formulas based on the set-up transfer ratio G . In addition, output angle thetap corresponds to the stroke position of the rack shaft 51, and further, since the stroke position of the rack shaft 51 corresponds to ***** of Wheel FW, it can detect output angle thetap from (1) formula by detecting steering angle thetah and angle-of-rotation thetam , and can detect ***** of Wheel FW based on this detected output angle thetap .

[0028] Thus, the transfer-ratio adjustable mechanism 100 to constitute and motion control of the lock mechanism 130 are carried out by the steering control unit 70, and based on each detection result of the steering angle sensor 60, the angle-of-rotation sensor 102, and the vehicle speed sensor 71, the steering control unit 70 outputs a control signal I_s to a motor 110, and carries out drive control of the transfer-ratio adjustable mechanism 30. moreover -- the time of a lock and lock release -- electromagnetism -- predetermined control of the energization control to a coil 154 etc. is carried out

[0029] Here, the processing carried out with the steering control unit 70 is explained along with the flow chart of drawing 5.

[0030] This flow chart starts by ON operation of an ignition switch. Since as for the inside of an OFF state the lock mechanism 130 of the transfer-ratio adjustable mechanism 100 operates and the ignition switch is in the lock state, first, it progresses to Step (a step is hereafter described as "S".) 200, and lock release control of which the lock state of the transfer-ratio adjustable mechanism 100 is canceled is performed.

[0031] This lock release control is shown in the flow chart of drawing 6.

[0032] first -- S202 -- electromagnetism -- energization is started in a coil 154 and driving force is given in the direction estranged from the lock electrode holder 140 to the lock arm 150

[0033] In S204 continuing, the predetermined control signal I_{start1} specified beforehand is outputted to a motor 110. This control signal I_{start1} is a control signal set up beforehand, in order to make a motor 110 reciprocate in vibration in the predetermined range, and sufficient range for the range made to reciprocate to cancel the bite lump by the engagement heights 151 of the lock arm 150 and the engagement crevice 141 of the lock electrode holder 140 is set up. And in S206 continuing, the angle of rotation thetam1 of the motor 110 at the time of ending processing of S204 is read.

[0034] In S208 continuing, the predetermined control signal I_{start2} specified beforehand is outputted to a motor 110. This control signal I_{start2} is a control signal beforehand set up so that the lock electrode holder 140 might rotate by the angle of rotation which serves as size from the formation width of face of the engagement crevice 141. And in S210 continuing, the angle of rotation thetam2 of the motor 110 at the time of ending processing of S208 is read.

[0035] The deflection Δ of an angle of rotation thetam2 and an angle of rotation thetam1 is set up as $\Delta = \text{thetam2} - \text{thetam1}$, and it judges whether deflection Δ is more than threshold Δ_{th} by S214 continuing S212 continuing. This threshold Δ_{th} is taken as the angle of rotation of the motor 110 corresponding to the formation width of face of the engagement crevice 141 in the lock electrode holder 140.

[0036] Consequently, when judged as "Yes" by S214, the lock electrode holder 140 is rotating more than the formation width of face of the engagement crevice 141, it can check that the stop with the lock arm 150 has been canceled by this, and this routine is ended as it is. On the other hand, when judged as "No" by S214, by some causes, such as a malfunction of a bite lump or the lock arm 150, can judge it as that by which stop release with the lock electrode holder 140 and the lock arm 150 was not carried out, progress to S216 in this case, the trouble indication lamp in which failure of the lock mechanism 130 is shown is made to turn on, an operator is told about generating of failure, and this routine is ended.

[0037] Thus, immediately after ON operation of an ignition switch, lock release control shown by S202-S216 is performed. In addition, especially the order of processing of S202 and S204 may not limit, and

may be performed simultaneously.

[0038] It progresses to S102, after returning to drawing 5 again and performing lock release control (S200). In S102, the vehicle speed V detected by steering angle thetah detected by the steering angle sensor 60, angle-of-rotation thetam of the motor 110 detected by the angle-of-rotation sensor 102, and the vehicle speed sensor 71 is read, respectively.

[0039] continuing -- S -- 104 -- **** -- drawing 7 -- being shown -- the vehicle speed -- V -- a transfer ratio -- G -- a relation -- being shown -- a map -- from -- S -- 102 -- having read -- the vehicle speed -- V -- a basis -- a map -- reference -- carrying out -- the vehicle speed -- V -- having responded -- a transfer ratio -- G -- setting up -- continuing -- S -- 106 -- **** -- the above -- (-- three --) -- a formula -- using -- S -- 102 -- having read

[0040] In S108 continuing, the angle deflection e of target angle-of-rotation thetamm set up by S106 and angle-of-rotation thetam read by S102 is set up as $e = \text{thetamm} - \text{thetam}$.

[0041] In S110 continuing, without overshooting, the control signal Is which controls a motor 110 is determined so that deflection e may be set to 0. As an example of this processing, a control signal Is can be determined by setting up the parameter of PID control appropriately based on the operation expression of $Is = C(s)$ and e. In addition, (s) in a formula is the Laplacian operator.

[0042] Processing after S102 mentioned above is repeated and performed until output the control signal Is determined by S110 to a motor 110 in S112 continuing, drive a motor 110 according to a control signal Is, it progresses to S114 after this, and it judges whether OFF operation of the ignition switch (IG) was carried out, and returns S102 in "No" and is judged as "Yes" by S114.

[0043] And when OFF operation of the ignition switch is carried out, it progresses to "Yes") and S300 by (S114, and lock control which locks the transfer-ratio adjustable mechanism 100 is performed.

[0044] This lock control is shown in the flow chart of drawing 8.

[0045] S310 -- first -- electromagnetism -- the energization to a coil 154 is stopped This tilts the lock arm 150 to the lock electrode-holder 140 side centering on the support pin 152 according to the stability of a spring 153.

[0046] In S312 continuing, angle-of-rotation thetam of the motor 110 in which the rotation position of the lock electrode holder 140 at this time is shown is read.

[0047] The lock electrode holder 140 chooses as the steering control unit 70 nearby position thetamr which can be locked to angle-of-rotation thetam read by S312 by S314 which is made to memorize beforehand the rotation position in which the lock arm 150 and a lock are possible, and continues.

[0048] And position thetamr which was chosen by S314 and which can be locked is treated as a target angle of rotation, and the same processing as S108-S112 which were mentioned above is carried out in S316-S320 which are carried out henceforth.

[0049] By carrying out such lock control processing, since the rotation drive of the lock electrode holder 140 is carried out to the position which can be locked, the engagement heights 151 of the lock arm 150 are certainly inserted into the engagement crevice 141 of the lock electrode holder 140, and lock operation is ensured.

[0050] Moreover, lock control of S300 can also be carried out as shown in drawing 9.

[0051] S330 [first,] -- electromagnetism -- after stopping energization of 154 to a coil, using the deflection Econst specified beforehand, a control signal Is is set up as $Is = C(s)$ and Econst, and a motor 110 is driven S332 according to the control signal Is set up by S332 by S334

[0052] This deflection Econst is the value specified as angle deflection corresponding to the formation pitch of the engagement crevice 141 formed in the lock electrode holder 140, and lock operation is ensured, in order that the engagement crevice 141 of the lock electrode holder 140 may surely pass through the position which faces the engagement heights 151 of the lock arm 150, while the lock electrode holder 140 rotates by the formation pitch of the engagement crevice 141.

[0053] And it progresses after [S336] predetermined-time progress, angle-of-rotation thetam of the motor 110 in which the rotation position of the lock electrode holder 140 at this time is shown is read, and angle-of-rotation thetam read by S336 judges whether it is the position which was memorized beforehand and which can be locked in S338 continuing. By this judgment, in "Yes", since it can check

that lock operation with the lock electrode holder 140 and the lock arm 150 has been ensured, this routine is ended as it is. In "No", the lock electrode holder 140 and the lock arm 150 did not stop mutually by a certain cause by S338, but the lock electrode holder 140 passed the position which can be locked, and it rotated, or means that rotation had stopped before the position which can be locked. In such a case, the trouble indication lamp in which it progresses to S340 and failure of the lock mechanism 130 is shown is made to turn on, an operator is told about generating of failure, and this routine is ended.

[0054] In addition, when judged with "No" by judgment of S338, the processing after S330 can be repeated the number of predetermined times, and can be carried out, and it can also consider as a flow which progresses to S340 after that.

[0055] Although the lock electrode holder 140 and the lock arm 150 are illustrated as a lock mechanism 130 with the operation gestalt explained above, it does not limit to this configuration or arrangement state, and if it is the lock mechanism 130 which formed the crevice in one side and formed heights in another side, it will not limit especially.

[0056] Moreover, lock operation and lock release operation which were explained with the operation gestalt cannot be limited to the explained example, and can be applied also to lock operation and lock release operation which are carried out at the time of a rack stroke and a hit, and the fail of a system.

[0057]

[Effect of the Invention] Since lock control means perform [according to the steering control unit for vehicles concerning each claim] motion control of a motor in addition to the motion control of driving means as explained above, at the time of a lock rotation -- when it becomes possible to certainly make in agreement the physical relationship of the section of a member which can be stopped, and a tilting member and the bite lump has arisen between the tilting member and the rotation member at the time of lock release, it becomes possible to carry out control of which this bite lump is canceled in operating a motor. Thus, it becomes possible to operate certainly the lock mechanism 130 of a transfer-ratio adjustable mechanism.

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the steering control unit for vehicles equipped with the transfer-ratio adjustable mechanism.

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PRIOR ART

[Description of the Prior Art] The steering control unit which carried from the former the transfer-ratio adjustable mechanism in which the transfer ratio between the steering angle of a steering handle and ***** of ***** was changed is known. For example, the steering control unit which equipped JP, 11-34894, A with the lock mechanism which locks the differential mechanism in such a transfer-ratio adjustable mechanism is indicated. This lock mechanism is the mechanism in which the heights of the lock arm fixed to the motor housing side are stopped, to the crevice of the body of revolution fixed to the motor axis of rotation of a transfer-ratio adjustable mechanism.

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EFFECT OF THE INVENTION

[Effect of the Invention] Since lock control means perform [according to the steering control unit for vehicles concerning each claim] motion control of a motor in addition to the motion control of driving means as explained above, it is at the time of a lock. rotation -- when it becomes possible to certainly make in agreement the physical relationship of the section of a member which can be stopped, and a tilting member and the bite lump has arisen between the tilting member and the rotation member at the time of lock release, it becomes possible to carry out control of which this bite lump is canceled in operating a motor. Thus, it becomes possible to operate certainly the lock mechanism 130 of a transfer-ratio adjustable mechanism.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Thus, since a lock mechanism was a mechanism with which a crevice and heights are made to engage, the physical relationship of the crevice of body of revolution and the heights of a lock arm was not in agreement, at the time of a lock, there may be no lock from skillful ****, and there was a case where there was no lock release in skillful ****, by the bite lump by the lock arm and body of revolution at it at the time of lock release.

[0004] this invention is made that such a technical problem should be solved, and the purpose is in offering the steering control unit for vehicles which may operate the lock mechanism of a transfer-ratio adjustable mechanism certainly.

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MEANS

[Means for Solving the Problem] Then, the steering control unit for vehicles concerning a claim 1 A transfer-ratio adjustable means to be the steering control unit for vehicles which performs steering control of vehicles, to have the output shaft connected with an input-shaft [which is connected with a steering handle side], and ***** side, and to change the transfer ratio between input-shaft-output shafts by the rotation drive of a motor, A rotation position detection means to detect the rotation position of a motor, and the tilting member supported free [tilting] to the stator side which constitutes a motor, The driving means to which a tilting member is made to tilt, and the rotation member which is fixed to Rota which constitutes a motor and has the section in which a tilting member and a stop are possible, and which can be stopped at intervals of predetermined, Motion control of a motor is performed with the motion control of driving means, and the lock control means which control a stop with a tilting member and a rotation member and stop release are had and constituted.

[0006] Although the lock and lock release of a differential mechanism in a transfer-ratio adjustable means are made by a stop with a tilting member and a rotation member, and stop release, in addition to the motion control of driving means, lock control means perform motion control of a motor in this case. thereby -- the time of a lock -- rotation -- when it becomes possible to certainly make in agreement the physical relationship of the section of a member which can be stopped, and a tilting member and the bite lump has arisen between the tilting member and the rotation member at the time of lock release, control of which this bite lump is canceled in operating a motor can be carried out

[0007] lock control means [in / a claim 1 / in the steering control unit for vehicles concerning a claim 2] -- a tilting member -- rotation -- a member -- the rotation detected by the tilting control means which make driving means drive so that it may tilt to a side, and the rotation position detection means -- the rotation position of a member and the rotation drive motor control / motor / means based on a position error with the section which can be stopped are had and constituted

[0008] tilting control means -- a tilting member -- rotation -- a member -- a rotation member is rotated by the motor control means to the section which can be stopped based on the position error which got mixed up with this control and was detected at the same time it makes it tilt in a side, i.e., the lock direction Thereby, a rotation member and a tilting member can be stopped certainly.

[0009] lock control means [in / a claim 1 / in the steering control unit for vehicles concerning a claim 3] -- a tilting member -- rotation -- a member -- the tilting control means which make driving means drive, and the motor control means which carries out the rotation drive of the motor at least more than the formation interval of the section which can be stopped are had and constituted so that it may tilt to a side

[0010] rotating a rotation member at least by the motor control means more than the formation interval of the section which can be stopped, after making a tilting member tilt in the lock direction by tilting control means -- rotation -- since the section of a member which can be stopped serves as the situation of surely passing through the position which faces a tilting member, a rotation member and a tilting member can be stopped certainly

[0011] When the rotation of the motor by which the lock control means in a claim 3 are obtained based

on the detection result of a rotation position detection means becomes more than the formation interval of the section which can be stopped, the steering control unit for vehicles concerning a claim 4 equips further the lock mechanism by the tilting member and the rotation member with a failure judging means judge it as what failure generated, and constitutes.

[0012] Although rotation of a motor will stop if a rotation member stops with a tilting member, when failure occurs in a lock mechanism, a tilting member and a rotation member do not stop mutually, but a *motor continues rotation more than the formation interval of the section which can be stopped*. This situation is judged by the failure judging means.

[0013] The steering control unit for vehicles concerning a claim 5 equips with and constitutes the tilting control means which make driving means drive, and a motor control means to make a motor reciprocate in the predetermined range so that a tilting member may estrange [the lock control means in a claim 1] from a rotation member.

[0014] Although a tilting member is made to tilt by tilting control means at the time of lock release so that it may estrange from a rotation member, a motor is made to reciprocate in the predetermined range by the motor control means at the time of this control processing, thereby -- a tilting member -- receiving -- rotation -- it will be in the state where the section of a member which can be stopped displaces in vibration, and it acts so that the bite lump between a tilting member and a rotation member may be canceled by this movement

[0015]

[Embodiments of the Invention] Hereafter, with reference to an accompanying drawing, it explains about the operation form of this invention.

[0016] The composition of the steering control unit which equipped drawing 1 with the transfer-ratio adjustable mechanism concerning the 1st operation form is shown.

[0017] The transfer-ratio adjustable mechanism 100 has the input shaft 20 connected with the steering handle 10 side, and the output shaft 40 connected with Wheel FW side, and has formed the steering angle sensor 60 which detects steering angle θ of the steering handle 10 to the input shaft 20. Moreover, the output shaft 40 is connected with the rack shaft 51 through the gear equipment 50 of a rack-and-pinion formula, and Wheel FW is connected with the both sides of the rack shaft 51.

[0018] The transfer-ratio adjustable mechanism 100 is expanded and is roughly shown in drawing 2 . The transfer-ratio adjustable mechanism 100 is equipped with the motor 110, the reducer 120, and the lock mechanism 130, and has the function to change the transfer ratio of the rotation between the input-shaft 20-output shafts 40.

[0019] A motor 110 is equipped with the angle-of-rotation sensor 102 (refer to drawing 1) which detects angle-of-rotation θ of a motor, and constitutes the servo motor which can control a rotation position while it is equipped with the stator 111 fixed in the motor housing 101, and Rota 112 supported free [rotation in the motor housing 101].

[0020] The reducer 120 constitutes the epicyclic gear mechanism and is fixing the sun gear 121 located in a core to the axis of rotation 113 rotated in one with Rota 112. Moreover, to it, the planetary gear 122 which revolves the circumference of a sun gear 121 around the sun is arranged at equal intervals, rotating around a sun gear 121, and each planetary gear 122 is supported free [rotation] with the carrier 123 connected with the input shaft 20. The starter ring 124 formed in the inner skin of the motor housing 101 is allotted, and the motor housing 101 is connected with an output shaft 40, and is constituted so that each planetary gear 122 may furthermore be surrounded.

[0021] Moreover, the part shown by the A-A line between a motor 110 and a reducer 120 is equipped with the lock mechanism 130 which locks the differential mechanism of a transfer-ratio adjustable mechanism. This lock mechanism 130 equips with and constitutes the lock electrode holder 140 of a disk configuration, and the lock arm 150 which curved circularly, as shown in drawing 3 .

[0022] It is fixed to the axis of rotation 113 which penetrates a core, and the lock electrode holder 140 rotates the lock electrode holder 140, the axis of rotation 113, and Rota 112 in one. Moreover, the engagement crevice 141 is formed in the periphery section of the lock electrode holder 140 at the predetermined intervals.

[0023] On the other hand, the lock arm 150 projects and forms in the lock electrode-holder 140 side the engagement heights 151 engaged in the engagement crevice 141 of the lock electrode holder 140. moreover, the end face section of the lock arm 150 is supported free [tilting] centering on the support pin 152 by the support pin 152 fixed to the motor housing 101 -- having -- **** -- the point of the lock arm 150 -- electromagnetism -- a coil 154 -- having -- this electromagnetism -- the metal plate (magnet board) 155 fixed to the position which faces a coil 154 at the motor housing 101 side is arranged Furthermore, the other end of the spring 153 which fixed the end to the motor housing 101 is being fixed to the point of the lock arm 150.

[0024] Thus, as the lock arm 150 is always energized by the operation of a spring 153 so that it may tilt to the lock electrode-holder 140 side centering on the support pin 152, and it is shown in drawing 3 , it will be in the state where the engagement heights 151 of the lock arm 150 enter in the engagement crevice 141 of the lock electrode holder 140, the lock electrode holder 140 and the lock arm 150 of each other are stopped, and, thereby, relative rotation with the motor housing 101 and Rota 112 is prevented. For this reason, the operation of the adjustable mechanism of a transfer ratio becomes impossible, and the transfer-ratio adjustable mechanism 100 will be in a lock state.

[0025] on the other hand -- electromagnetism -- if energized by the coil 154 -- between metal plates 155 -- electromagnetism -- as shown in drawing 4 , repulsive force [-like] occurs, the lock arm 150 is tilted so that it may estrange from the lock electrode holder 140, the engagement heights 151 of the lock arm 150 move out of the engagement crevice 141 of the lock electrode holder 140, and a stop with the lock electrode holder 140 and the lock arm 150 is canceled by the operation This will be in the state which the motor housing 101 and Rota 112 can relative rotate, and the transfer-ratio adjustable mechanism 100 is the mechanism canceled of a lock state.

[0026] If the angle of rotation of an output shaft 40 is set to output angle thetap here, since the relation of steering angle thetah, angle-of-rotation thetam of a motor 110, and output angle thetap will turn into a relation shown by (1) formula and the relation of steering angle thetah, output angle thetap, and a transfer ratio G will be prescribed by (2) formulas, (3) formulas can show angle-of-rotation thetam of a motor 110 from (1) formula and (2) formulas. In addition, "K" in a formula is the reduction gear ratio of a reducer 120.

[0027]

$\text{thetap} = \text{thetah} + K \cdot \text{thetam}$ -- (1)

$\text{thetap} = G \cdot \text{thetah}$ -- (2)

$\text{thetam} = (G - 1) \cdot \text{thetah} / K$ -- (3)

Therefore, transfer-ratio control between the input-shaft 20-output shafts 40 can be performed by controlling angle-of-rotation thetam of a motor 110 according to steering angle thetah based on (3) formulas based on the set-up transfer ratio G. In addition, output angle thetap corresponds to the stroke position of the rack shaft 51, and further, since the stroke position of the rack shaft 51 corresponds to ***** of Wheel FW, it can detect output angle thetap from (1) formula by detecting steering angle thetah and angle-of-rotation thetam, and can detect ***** of Wheel FW based on this detected output angle thetap.

[0028] Thus, the transfer-ratio adjustable mechanism 100 to constitute and motion control of the lock mechanism 130 are carried out by the steering control unit 70, and based on each detection result of the steering angle sensor 60, the angle-of-rotation sensor 102, and the vehicle speed sensor 71, the steering control unit 70 outputs a control signal Is to a motor 110, and carries out drive control of the transfer-ratio adjustable mechanism 30. moreover -- the time of a lock and lock release -- electromagnetism -- predetermined control of the energization control to a coil 154 etc. is carried out

[0029] Here, the processing carried out with the steering control unit 70 is explained along with the flow chart of drawing 5 .

[0030] This flow chart starts by ON operation of an ignition switch. Since as for the inside of an OFF state the lock mechanism 130 of the transfer-ratio adjustable mechanism 100 operates and the ignition switch is in the lock state, first, it progresses to Step (a step is hereafter described as "S".) 200, and lock release control of which the lock state of the transfer-ratio adjustable mechanism 100 is canceled is

performed.

[0031] This lock release control is shown in the flow chart of drawing 6.

[0032] first -- S202 -- electromagnetism -- energization is started in a coil 154 and driving force is given in the direction estranged from the lock electrode holder 140 to the lock arm 150

[0033] In S204 continuing, the predetermined control signal Istart1 specified beforehand is outputted to a motor 110. This control signal Istart1 is a control signal set up beforehand, in order to make a motor 110 reciprocate in vibration in the predetermined range, and sufficient range for the range made to reciprocate to cancel the bite lump by the engagement heights 151 of the lock arm 150 and the engagement crevice 141 of the lock electrode holder 140 is set up. And in S206 continuing, the angle of rotation θ_{am1} of the motor 110 at the time of ending processing of S204 is read.

[0034] In S208 continuing, the predetermined control signal Istart2 specified beforehand is outputted to a motor 110. This control signal Istart2 is a control signal beforehand set up so that the lock electrode holder 140 might rotate by the angle of rotation which serves as size from the formation width of face of the engagement crevice 141. And in S210 continuing, the angle of rotation θ_{am2} of the motor 110 at the time of ending processing of S208 is read.

[0035] The deflection $\Delta\theta$ of an angle of rotation θ_{am2} and an angle of rotation θ_{am1} is set up as $\Delta\theta = \theta_{am2} - \theta_{am1}$, and it judges whether deflection $\Delta\theta$ is more than threshold $\Delta\theta_{th}$ by S214 continuing S212 continuing. This threshold $\Delta\theta_{th}$ is taken as the angle of rotation of the motor 110 corresponding to the formation width of face of the engagement crevice 141 in the lock electrode holder 140.

[0036] Consequently, when judged as "Yes" by S214, the lock electrode holder 140 is rotating more than the formation width of face of the engagement crevice 141, it can check that the stop with the lock arm 150 has been canceled by this, and this routine is ended as it is. On the other hand, when judged as "No" by S214, by some causes, such as a malfunction of a bite lump or the lock arm 150, can judge it as that by which stop release with the lock electrode holder 140 and the lock arm 150 was not carried out, progress to S216 in this case, the trouble indication lamp in which failure of the lock mechanism 130 is shown is made to turn on, an operator is told about generating of failure, and this routine is ended.

[0037] Thus, immediately after ON operation of an ignition switch, lock release control shown by S202-S216 is performed. In addition, especially the order of processing of S202 and S204 may not limit, and may be performed simultaneously.

[0038] It progresses to S102, after returning to drawing 5 again and performing lock release control (S200). In S102, the vehicle speed V detected by steering angle θ_{th} detected by the steering angle sensor 60, angle-of-rotation θ_{am} of the motor 110 detected by the angle-of-rotation sensor 102, and the vehicle speed sensor 71 is read, respectively.

[0039] continuing -- S -- 104 -- **** -- drawing 7 -- being shown -- the vehicle speed -- V -- a transfer ratio -- G -- a relation -- being shown -- a map -- from -- S -- 102 -- having read -- the vehicle speed -- V -- a basis -- a map -- reference -- carrying out -- the vehicle speed -- V -- having responded -- a transfer ratio -- G -- setting up -- continuing -- S -- 106 -- **** -- the above -- (-- three --) -- a formula -- using -- S -- 102 -- having read

[0040] In S108 continuing, the angle deflection e of target angle-of-rotation θ_{amm} set up by S106 and angle-of-rotation θ_{am} read by S102 is set up as $e = \theta_{amm} - \theta_{am}$.

[0041] In S110 continuing, without overshooting, the control signal I_s which controls a motor 110 is determined so that deflection e may be set to 0. As an example of this processing, a control signal I_s can be determined by setting up the parameter of PID control appropriately based on the operation expression of $I_s = C(s)$ and e . In addition, (s) in a formula is the Laplacian operator.

[0042] Processing after S102 mentioned above is repeated and performed until output the control signal I_s is determined by S110 to a motor 110 in S112 continuing, drive a motor 110 according to a control signal I_s , it progresses to S114 after this, and it judges whether OFF operation of the ignition switch (IG) was carried out, and returns S102 in "No" and is judged as "Yes" by S114.

[0043] And when OFF operation of the ignition switch is carried out, it progresses to "Yes") and S300 by (S114, and lock control which locks the transfer-ratio adjustable mechanism 100 is performed.

[0044] This lock control is shown in the flow chart of drawing 8.

[0045] S310 -- first -- electromagnetism -- the energization to a coil 154 is stopped This tilts the lock arm 150 to the lock electrode-holder 140 side centering on the support pin 152 according to the stability of a spring 153.

[0046] In S312 continuing, angle-of-rotation θ_{tam} of the motor 110 in which the rotation position of the lock electrode holder 140 at this time is shown is read.

[0047] The lock electrode holder 140 chooses as the steering control unit 70 nearby position θ_{tamr} which can be locked to angle-of-rotation θ_{tam} read by S312 by S314 which is made to memorize beforehand the rotation position in which the lock arm 150 and a lock are possible, and continues.

[0048] And position θ_{tamr} which was chosen by S314 and which can be locked is treated as a target angle of rotation, and the same processing as S108-S112 which were mentioned above is carried out in S316-S320 which are carried out henceforth.

[0049] By carrying out such lock control processing, since the rotation drive of the lock electrode holder 140 is carried out to the position which can be locked, the engagement heights 151 of the lock arm 150 are certainly inserted into the engagement crevice 141 of the lock electrode holder 140, and lock operation is ensured.

[0050] Moreover, lock control of S300 can also be carried out as shown in drawing 9.

[0051] S330 [first,] -- electromagnetism -- after stopping energization of 154 to a coil, using the deflection E_{const} specified beforehand, a control signal I_s is set up as $I_s = C(s)$ and E_{const} , and a motor 110 is driven S332 according to the control signal I_s set up by S332 by S334

[0052] This deflection E_{const} is the value specified as angle deflection corresponding to the formation pitch of the engagement crevice 141 formed in the lock electrode holder 140, and lock operation is ensured, in order that the engagement crevice 141 of the lock electrode holder 140 may surely pass through the position which faces the engagement heights 151 of the lock arm 150, while the lock electrode holder 140 rotates by the formation pitch of the engagement crevice 141.

[0053] And it progresses after [S336] predetermined-time progress, angle-of-rotation θ_{tam} of the motor 110 in which the rotation position of the lock electrode holder 140 at this time is shown is read, and angle-of-rotation θ_{tam} read by S336 judges whether it is the position which was memorized beforehand and which can be locked in S338 continuing. By this judgment, in "Yes", since it can check that lock operation with the lock electrode holder 140 and the lock arm 150 has been ensured, this routine is ended as it is. In "No", the lock electrode holder 140 and the lock arm 150 did not stop mutually by a certain cause by S338, but the lock electrode holder 140 passed the position which can be locked, and it rotated, or means that rotation had stopped before the position which can be locked. In such a case, the trouble indication lamp in which it progresses to S340 and failure of the lock mechanism 130 is shown is made to turn on, an operator is told about generating of failure, and this routine is ended.

[0054] In addition, when judged with "No" by judgment of S338, the processing after S330 can be repeated the number of predetermined times, and can be carried out, and it can also consider as a flow which progresses to S340 after that.

[0055] Although the lock electrode holder 140 and the lock arm 150 are illustrated as a lock mechanism 130 with the operation form explained above, it does not limit to this configuration or arrangement state, and if it is the lock mechanism 130 which formed the crevice in one side and formed heights in another side, it will not limit especially.

[0056] Moreover, lock operation and lock release operation which were explained with the operation form cannot be limited to the explained example, and can be applied also to lock operation and lock release operation which are carried out at the time of a rack stroke and a hit, and the fail of a system.

[Translation done.]

* NOTICES *

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing the composition of the steering control unit concerning an operation gestalt.

[Drawing 2] It is the cross section showing a transfer-ratio adjustable mechanism.

[Drawing 3] In the A-A line cross section in drawing 2, it is the plan of the lock mechanism which shows a lock state.

[Drawing 4] In the A-A line cross section in drawing 2, it is the plan of the lock mechanism which shows a lock release state.

[Drawing 5] It is the flow chart which shows adjustable control of a transfer ratio.

[Drawing 6] It is the flow chart which shows lock release control.

[Drawing 7] It is the map which specified the relation between the vehicle speed V and a transfer ratio G.

[Drawing 8] It is the flow chart which shows lock control.

[Drawing 9] It is the flow chart which shows lock control.

[Description of Notations]

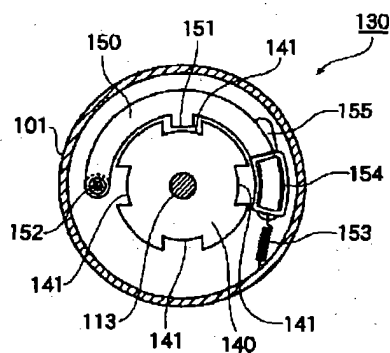
FW [-- Transfer-ratio adjustable mechanism] -- A wheel (*****), 10 -- A steering handle, 100

102 [-- Stator] -- An angle-of-rotation sensor, 110 -- A motor, 111

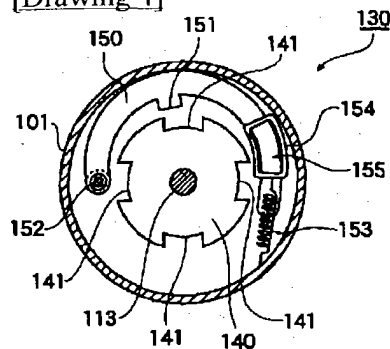
112 [-- A lock mechanism 140 / -- A lock electrode holder (rotation member), 141 / -- Engagement crevice (section which can be stopped)] -- Rota, 120 -- A reducer, 130

150 -- Lock arm (tilting member)

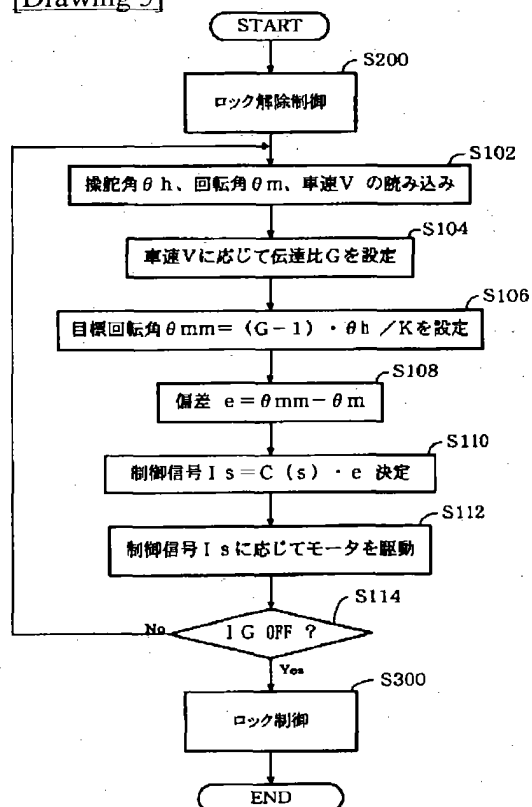
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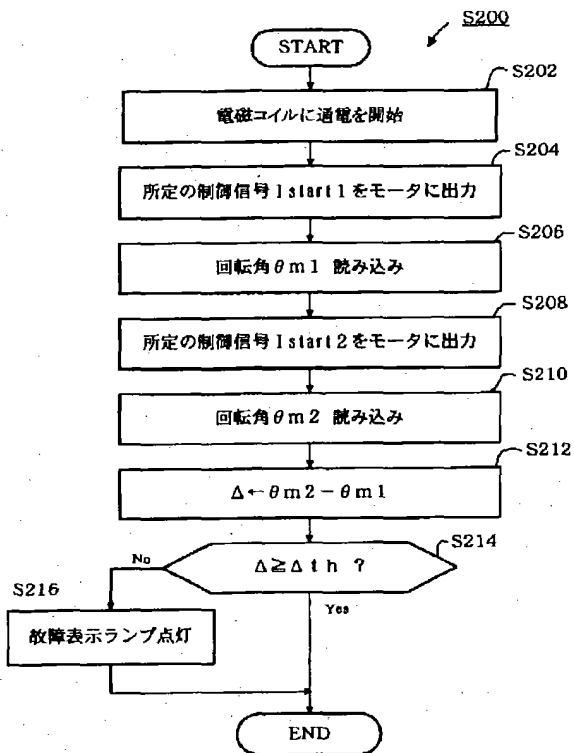
[Drawing 4]



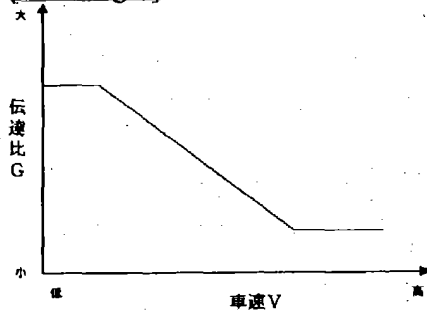
[Drawing 5]



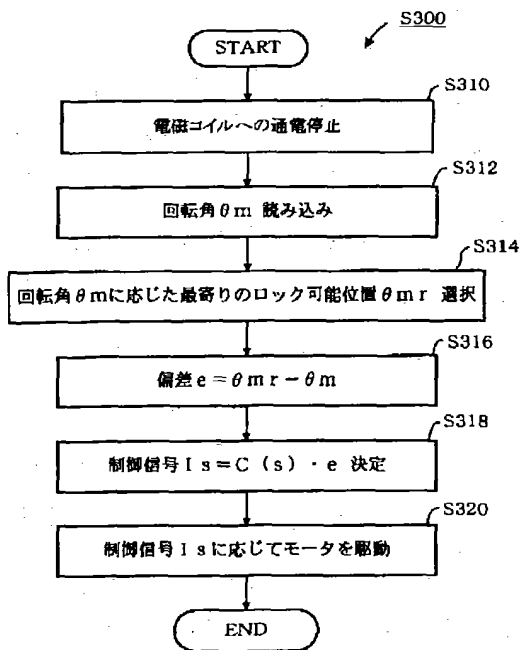
[Drawing 6]



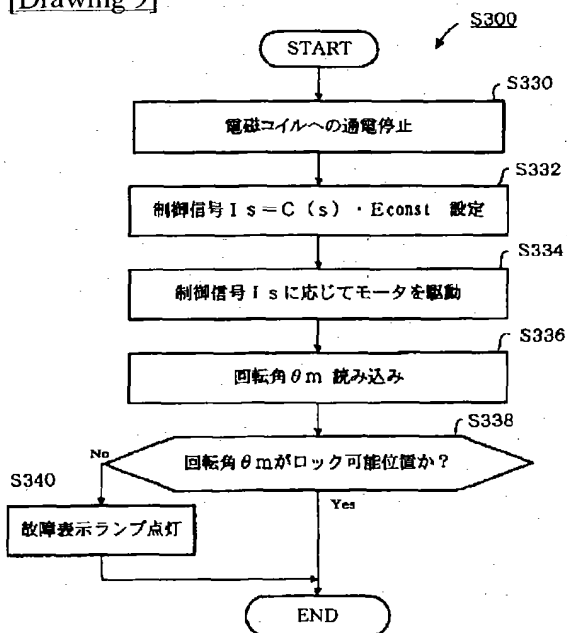
[Drawing 7]



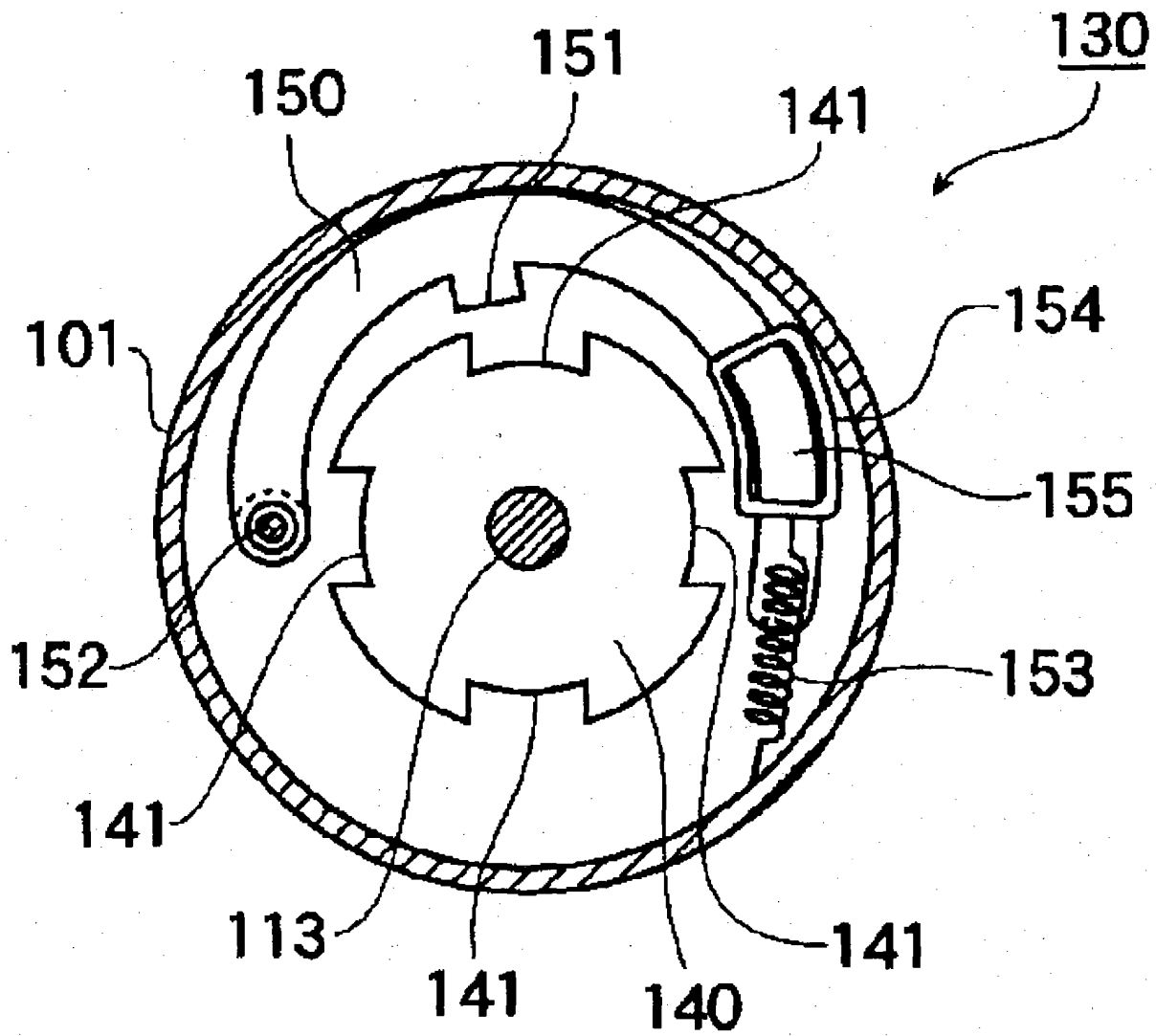
[Drawing 8]



[Drawing 9]



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(71) 出願人 000003207

トヨタ自動車株式会社
愛知県豊田市トヨタ町1番地

(72) 発明者 小城 隆博

愛知県豊田市トヨタ町1番地 トヨタ自動車株式会社内

(72) 発明者 河室 巡児

愛知県豊田市トヨタ町1番地 トヨタ自動車株式会社内

(74) 代理人 100088155

弁理士 長谷川 芳樹 (外1名)

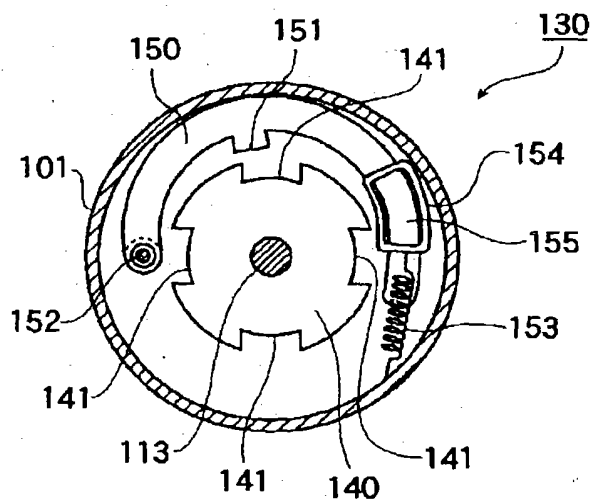
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(54) 【発明の名称】 車両用操舵制御装置

(57) 【要約】

【課題】 伝達比可変機構のロック機構がロックアームの凸部をロックホルダの凹部内に嵌合させる構造であり、位置偏差が生じてロックが掛からず、噛み込みによりロック解除ができない場合があった。

【解決手段】 ロック時にはロックホルダ140を最寄りのロック可能位置まで回転させ、ロック解除時にはロックホルダ140を振動的に往復動させて噛み込みを解除する。



【特許請求の範囲】

【請求項1】 車両の操舵制御を行う車両用操舵制御装置であって、
操舵ハンドル側に連結される入力軸と転舵輪側に連結される出力軸とを有し、モータの回転駆動により入力軸－出力軸間の伝達比を変化させる伝達比可変手段と、
前記モータの回転位置を検出する回転位置検出手段と、
前記モータを構成するステータ側に対し、傾動自在に支持された傾動部材と、
前記傾動部材を傾動させる駆動手段と、
前記モータを構成するロータに対して固定され、前記傾動部材と係止可能な係止可能部を所定間隔で有する回転部材と、
前記駆動手段の動作制御と共にモータの動作制御を行い、前記傾動部材と回転部材との係止及び係止解除を制御するロック制御手段とを備える車両用操舵制御装置。

【請求項2】 前記ロック制御手段は、
前記傾動部材が回転部材側に傾動するように、前記駆動手段を駆動させる傾動制御手段と、
前記回転位置検出手段によって検出された前記回転部材の回転位置と、前記係止可能部との位置偏差をもとに、前記モータを回転駆動するモータ制御手段とを備える請求項1記載の車両用操舵制御装置。

【請求項3】 前記ロック制御手段は、
前記傾動部材が回転部材側に傾動するように、前記駆動手段を駆動させる傾動制御手段と、
少なくとも前記係止可能部の形成間隔以上に、前記モータを回転駆動するモータ制御手段とを備える請求項1記載の車両用操舵制御装置。

【請求項4】 前記ロック制御手段は、
前記回転位置検出手段の検出結果をもとに得られる前記モータの回転量が、前記係止可能部の形成間隔以上となった場合に、前記傾動部材と回転部材とによるロック機構に故障が発生したものと判断する故障判定手段をさらに備える請求項3記載の車両用操舵制御装置。

【請求項5】 前記ロック制御手段は、
前記傾動部材が前記回転部材から離間するように、前記駆動手段を駆動させる傾動制御手段と、
前記モータを所定範囲で往復動させるモータ制御手段とを備える請求項1記載の車両用操舵制御装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、伝達比可変機構を備えた車両用操舵制御装置に関する。

【0002】

【従来の技術】従来から、操舵ハンドルの操舵角と転舵輪の転舵角との間の伝達比を変化させる伝達比可変機構を搭載した操舵制御装置が知られている。例えば特開平11-34894号には、このような伝達比可変機構における差動機構をロックするロック機構を備えた操舵制

御装置が開示されている。このロック機構は、伝達比可変機構のモータ回転軸に固定した回転体の凹部に対し、モータハウジング側に固定したロックアームの凸部を係止させる機構となっている。

【0003】

【発明が解決しようとする課題】このようにロック機構が、凹部と凸部とを係合させる機構であるため、ロック時には、回転体の凹部とロックアームの凸部との位置関係が一致せず、ロックが上手く掛からない場合があり、またロック解除時には、ロックアームと回転体との噛み込みにより、ロック解除が上手く行かない場合があった。

【0004】本発明はこのような課題を解決すべくされたものであり、その目的は、伝達比可変機構のロック機構を確実に動作させ得る車両用操舵制御装置を提供することにある。

【0005】

【課題を解決するための手段】そこで、請求項1にかかる車両用操舵制御装置は、車両の操舵制御を行う車両用操舵制御装置であって、操舵ハンドル側に連結される入力軸と転舵輪側に連結される出力軸とを有し、モータの回転駆動により入力軸－出力軸間の伝達比を変化させる伝達比可変手段と、モータの回転位置を検出する回転位置検出手段と、モータを構成するステータ側に対し、傾動自在に支持された傾動部材と、傾動部材を傾動させる駆動手段と、モータを構成するロータに対して固定され、傾動部材と係止可能な係止可能部を所定間隔で有する回転部材と、駆動手段の動作制御と共にモータの動作制御を行い、傾動部材と回転部材との係止及び係止解除を制御するロック制御手段とを備えて構成する。

【0006】傾動部材と回転部材との係止及び係止解除により、伝達比可変手段における差動機構のロック及びロック解除がなされるが、この際、ロック制御手段によって、駆動手段の動作制御に加え、モータの動作制御を行う。これにより、ロック時には、回転部材の係止可能部と傾動部材との位置関係を確実に一致させることが可能となり、またロック解除時に、傾動部材と回転部材との間に噛み込みが生じている場合にも、モータを動作させることでこの噛み込みを解除するような制御を実施し得る。

【0007】請求項2にかかる車両用操舵制御装置は、請求項1におけるロック制御手段が、傾動部材が回転部材側に傾動するように駆動手段を駆動させる傾動制御手段と、回転位置検出手段によって検出された回転部材の回転位置と、係止可能部との位置偏差をもとに、モータを回転駆動するモータ制御手段とを備えて構成する。

【0008】傾動制御手段によって傾動部材を回転部材側、すなわちロック方向に傾動させると同時に或いはこの制御と前後して、検出した位置偏差をもとに、モータ制御手段によって回転部材を係止可能部まで回転させ

る。これにより、回転部材と傾動部材とを確実に係止させることができる。

【0009】請求項3にかかる車両用操舵制御装置は、請求項1におけるロック制御手段が、傾動部材が回転部材側に傾動するように、駆動手段を駆動させる傾動制御手段と、少なくとも係止可能部の形成間隔以上に、モータを回転駆動するモータ制御手段とを備えて構成する。

【0010】傾動制御手段によって傾動部材をロック方向に傾動させた後、モータ制御手段によって回転部材を少なくとも係止可能部の形成間隔以上に回転させることで、回転部材の係止可能部が、傾動部材と相対する位置を必ず通過する状況となるので、回転部材と傾動部材とを確実に係止させることができる。

【0011】請求項4にかかる車両用操舵制御装置は、請求項3におけるロック制御手段が、回転位置検出手段の検出結果をもとに得られるモータの回転量が、係止可能部の形成間隔以上となった場合に、傾動部材と回転部材とによるロック機構に故障が発生したものと判断する故障判定手段をさらに備えて構成する。

【0012】回転部材が傾動部材と係止するとモータの回転が停止するが、ロック機構に故障が発生した場合には、傾動部材と回転部材とが互いに係止せず、係止可能部の形成間隔以上にモータが回転を続ける。この状況を故障判定手段によって判定する。

【0013】請求項5にかかる車両用操舵制御装置は、請求項1におけるロック制御手段が、傾動部材が回転部材から離間するように、駆動手段を駆動させる傾動制御手段と、モータを所定範囲で往復動させるモータ制御手段とを備えて構成する。

【0014】ロック解除時には、回転部材から離間するように、傾動制御手段によって傾動部材を傾動させるが、この制御処理時に、モータ制御手段によってモータを所定範囲で往復動させる。これにより、傾動部材に対して、回転部材の係止可能部が振動的に変位する状態となり、この動きにより、傾動部材と回転部材との間の噛み込みが解除されるように作用する。

【0015】

【発明の実施の形態】以下、本発明の実施形態につき、添付図面を参照して説明する。

【0016】図1に第1の実施形態にかかる伝達比可変機構を備えた操舵制御装置の構成を示す。

【0017】伝達比可変機構100は、操舵ハンドル10側に連結された入力軸20と、車輪FW側に連結された出力軸40とを有しており、入力軸20に対し、操舵ハンドル10の操舵角 θ_h を検出する操舵角センサ60を設けている。また、出力軸40は、ラックアンドピニオン式のギヤ装置50を介してラック軸51に連結されており、ラック軸51の両側には車輪FWが連結されている。

【0018】図2に、伝達比可変機構100を拡大して

概略的に示す。伝達比可変機構100は、モータ110、減速機120、ロック機構130を備えており、入力軸20-出力軸40間の回転量の伝達比を変化させる機能を有している。

【0019】モータ110は、モータハウジング101内に固定したステータ111と、モータハウジング101内に回転自在に支持されたロータ112とを備え、共に、モータの回転角 θ_m を検出する回転角センサ102（図1参照）を備えており、回転位置を制御可能なサーボモータを構成している。

【0020】減速機120は遊星歯車機構を構成しており、中心部に位置するサンギヤ121は、ロータ112と一体的に回転する回転軸113に固定している。また、サンギヤ121の周囲には、自転しつつサンギヤ121の周囲を公転するプラネタリギヤ122を等間隔で配置し、各プラネタリギヤ122は、入力軸20に連結されたキャリア123によって自転自在に支持されている。さらに各プラネタリギヤ122を囲むように、モータハウジング101の内周面に形成したリングギヤ124を配し、モータハウジング101を出力軸40に連結して構成している。

【0021】また、モータ110と減速機120との間における、A-A線で示す部位には、伝達比可変機構の差動機構をロックするロック機構130を備えている。このロック機構130は、図3に示すように、円盤形状のロックホルダ140と円弧状に湾曲したロックアーム150とを備えて構成している。

【0022】ロックホルダ140は、中心部を貫通する回転軸113に固定されており、ロックホルダ140、回転軸113及びロータ112は一体的に回転する。また、ロックホルダ140の周縁部には、所定の間隔で係合凹部141を形成している。

【0023】これに対し、ロックアーム150は、ロックホルダ140の係合凹部141内に係合する係合凸部151を、ロックホルダ140側に突出形成している。また、ロックアーム150の基端部は、モータハウジング101に固定した支持ピン152によって、支持ピン152を中心に傾動自在に支持されており、ロックアーム150の先端部には、電磁コイル154を備え、この電磁コイル154と相対する位置に、モータハウジング101側に固定した金属板（磁石板）155を配置している。さらに、ロックアーム150の先端部には、一端をモータハウジング101に固定したスプリング153の他端が固定されている。

【0024】このようにロックアーム150は、スプリング153の作用によって、支持ピン152を中心としてロックホルダ140側に傾動するように常時付勢されており、図3に示すように、ロックホルダ140の係合凹部141内にロックアーム150の係合凸部151が入り込む状態となって、ロックホルダ140とロックア

ーム150とが互いに係止され、これによりモータハウジング101とロータ112との相対回転が阻止される。このため、伝達比の可変機構が作動不可能となり、伝達比可変機構100がロック状態となる。

【0025】一方、電磁コイル154に通電されると、金属板155との間に電磁的な反発力が発生し、その作用によって、図4に示すように、ロックアーム150はロックホルダ140から離間するように傾動し、ロックアーム150の係合凸部151は、ロックホルダ140の係合凹部141の外に移動し、ロックホルダ140とロックアーム150との係止が解除される。これによりモータハウジング101とロータ112とは、相対回転が可能な状態となり、伝達比可変機構100がロック状態から解除される機構となっている。

【0026】ここで出力軸40の回転角を出力角 θ_p とすると、操舵角 θ_h 、モータ110の回転角 θ_m 、出力角 θ_p の関係は(1)式で示す関係となり、操舵角 θ_h 、出力角 θ_p 、伝達比 G の関係は(2)式で規定されるため、(1)式及び(2)式より、モータ110の回転角 θ_m は(3)式で示すことができる。なお、式中の「 K 」は減速機120の減速比である。

【0027】

$$\theta_p = \theta_h + K \cdot \theta_m \quad \dots (1)$$

$$\theta_p = G \cdot \theta_h \quad \dots (2)$$

$$\theta_m = (G - 1) \cdot \theta_h / K \quad \dots (3)$$

従って(3)式に基づいて、設定された伝達比 G をもとに操舵角 θ_h に応じてモータ110の回転角 θ_m を制御することで、入力軸20-出力軸40間の伝達比制御を行うことができる。なお、出力角 θ_p は、ラック軸51のストローク位置に対応し、さらにラック軸51のストローク位置は車輪FWの転舵角に対応するため、操舵角 θ_h 及び回転角 θ_m を検出することで(1)式より出力角 θ_p を検知することができ、この検知した出力角 θ_p をもとに車輪FWの転舵角が検知可能となっている。

【0028】このように構成する伝達比可変機構100及びそのロック機構130の動作制御は操舵制御装置70によって実施され、操舵制御装置70は、操舵角センサ60、回転角センサ102及び車速センサ71の各検出結果をもとに、モータ110に対して制御信号 I_s を出力して伝達比可変機構30の駆動制御を実施する。また、ロック時及びロック解除時には、電磁コイル154に対する通電制御等の所定の制御を実施する。

【0029】ここで、操舵制御装置70で実施される処理について、図5のフローチャートに沿って説明する。

【0030】このフローチャートはイグニションスイッチのオン操作によって起動する。イグニションスイッチがオフ状態中は、伝達比可変機構100のロック機構130が作動しロック状態となっているため、まず、ステップ(以下、ステップを「S」と記す。)200に進み、伝達比可変機構100のロック状態を解除するロ

ック解除制御を実行する。

【0031】このロック解除制御を図6のフローチャートに示す。

【0032】まずS202では、電磁コイル154に通電を開始して、ロックアーム150に対して、ロックホルダ140から離間する方向へ駆動力を与える。

【0033】続くS204では、予め規定した所定の制御信号 I_{start1} をモータ110に出力する。この制御信号 I_{start1} は、モータ110を所定の範囲で振動的に往復動させるために予め設定した制御信号であり、往復動させる範囲は、ロックアーム150の係合凸部151と、ロックホルダ140の係合凹部141との噛み込みを解除するに十分な範囲が設定されている。そして続くS206では、S204の処理を終了した時点におけるモータ110の回転角 θ_{m1} を読み込む。

【0034】続くS208では、予め規定した所定の制御信号 I_{start2} をモータ110に出力する。この制御信号 I_{start2} は、例えば係合凹部141の形成幅よりも大となる回転角でロックホルダ140が回転するように予め設定した制御信号である。そして続くS210では、S208の処理を終了した時点におけるモータ110の回転角 θ_{m2} を読み込む。

【0035】続くS212では、回転角 θ_{m2} と回転角 θ_{m1} との偏差 Δ を $\Delta = \theta_{m2} - \theta_{m1}$ として設定し、続くS214では偏差 Δ がしきい値 Δ_{th} 以上であるかを判断する。このしきい値 Δ_{th} は、例えばロックホルダ140における係合凹部141の形成幅に対応するモータ110の回転角とする。

【0036】その結果、S214で「Yes」と判断された場合には、ロックホルダ140がその係合凹部141の形成幅以上に回転しており、これによりロックアーム150との係止が解除されたことが確認でき、このままこのルーチンを終了する。これに対し、S214で「No」と判断された場合には、噛み込みやロックアーム150の動作不良等、何らかの原因で、ロックホルダ140とロックアーム150との係止解除が遂行されなかったものと判断でき、この場合にはS216に進んで、ロック機構130の故障を示す故障表示ランプを点灯させ、運転者に故障の発生を知らせこのルーチンを終了する。

【0037】このように、イグニションスイッチのオン操作直後には、S202～S216で示したロック解除制御を実行する。なお、S202とS204の処理順は、特に限定するものではなく、同時に実行しても良い。

【0038】再び図5に戻り、ロック解除制御(S200)を実行した後、S102に進む。S102では、操舵角センサ60で検出された操舵角 θ_h 、回転角センサ102で検出されたモータ110の回転角 θ_m 、車速センサ71で検出された車速 V をそれぞれ読み込む。

【0039】続くS104では、図7に示す車速Vと伝達比Gとの関係を示すマップから、S102で読み込んだ車速Vをもとにマップ検索し、車速Vに応じた伝達比Gを設定し、続くS106では、前出の(3)式を用い、S102で読み込んだ操舵角 θ_h 及びS104で設定した伝達比Gをもとに、モータ110の目標回転角 θ_{mm} を設定する。

【0040】続くS108では、S106で設定された目標回転角 θ_{mm} と、S102で読み込まれた回転角 θ_m との角度偏差 e を、 $e = \theta_{mm} - \theta_m$ として設定する。

【0041】続くS110では、オーバーシュートすることなく偏差 e を0にするように、モータ110を制御する制御信号 I_s を決定する。この処理の一例としては、 $I_s = C(s) \cdot e$ の演算式に基づいて、PID制御のパラメータを適切に設定することにより制御信号 I_s を決定することができる。なお、式中の (s) はラプラス演算子である。

【0042】続くS112では、S110で決定された制御信号 I_s をモータ110に出力し、制御信号 I_s に応じてモータ110を駆動し、その後S114に進み、イグニションスイッチ(IG)がオフ操作されたかを判断し、「No」の場合にはS102に戻り、S114で「Yes」と判断されるまで、前述したS102以降の処理を繰り返し実行する。

【0043】そして、イグニションスイッチがオフ操作された場合には(S114で「Yes」)、S300に進み、伝達比可変機構100をロックするロック制御を実行する。

【0044】このロック制御を図8のフローチャートに示す。

【0045】S310では、まず電磁コイル154への通電を停止する。これによりロックアーム150は、スプリング153の復元力によって、支持ピン152を中心にロックホルダ140側へ傾動する。

【0046】続くS312ではこのときのロックホルダ140の回転位置を示すモータ110の回転角 θ_m を読み込む。

【0047】操舵制御装置70には、ロックホルダ140がロックアーム150とロック可能な回転位置を予め記憶させており、続くS314では、S312で読み込んだ回転角 θ_m に対し、最寄りのロック可能位置 θ_{mr} を選択する。

【0048】そして、以降に実施されるS316～S320では、S314で選択したロック可能位置 θ_{mr} を目標回転角として扱い、前述したS108～S112と同様の処理を実施する。

【0049】このようなロック制御処理を実施することで、ロックホルダ140がロック可能位置まで回転駆動されるため、ロックアーム150の係合凸部151がロ

ックホルダ140の係合凹部141内に確実に挿入され、ロック動作が確実に行われる。

【0050】また、S300のロック制御は、図9に示すように実施することもできる。

【0051】まず、S330で電磁コイルへ154の通電を停止した後、S332では予め規定した偏差 E_{const} を用いて、制御信号 I_s を $I_s = C(s) \cdot E_{const}$ として設定し、S334ではS332で設定した制御信号 I_s に応じてモータ110を駆動する。

【0052】この偏差 E_{const} は、ロックホルダ140に形成された係合凹部141の形成ピッチに対応する角度偏差として規定した値であり、ロックホルダ140が係合凹部141の形成ピッチ分だけ回転する間に、ロックホルダ140の係合凹部141がロックアーム150の係合凸部151に相対する位置を必ず通過するため、ロック動作が確実に行われるものである。

【0053】そして所定時間経過後S336に進み、このときのロックホルダ140の回転位置を示すモータ110の回転角 θ_m を読み込み、続くS338では、S336で読み込んだ回転角 θ_m が予め記憶したロック可能位置であるかを判断する。この判断で「Yes」の場合には、ロックホルダ140とロックアーム150とのロック動作が確実に行われたことが確認できるため、このままこのルーチンを終了する。S338で「No」の場合には、何らかの原因でロックホルダ140とロックアーム150とが互いに係止せず、ロックホルダ140がロック可能位置を過ぎて回転したか或いはロック可能位置の手前で回転が停止したことになる。このような場合には、S340に進みロック機構130の故障を示す故障表示ランプを点灯させ、運転者に故障の発生を知らせこのルーチンを終了する。

【0054】なお、S338の判断で「No」と判定された場合には、S330以降の処理を所定回数繰り返して実施し、その後、S340に進むようなフローとすることもできる。

【0055】以上説明した実施形態では、ロック機構130としてロックホルダ140とロックアーム150とを例示したが、この形状や配置状態に限定するものではなく、一方に凹部、他方に凸部を形成したロック機構130であれば、特に限定するものではない。

【0056】また、実施形態で説明したロック動作及びロック解除動作は、説明した例に限定するものではなく、例えば、ラックストロークエンド当たり時やシステムのフェイル時に実施されるロック動作及びロック解除動作にも適用することができる。

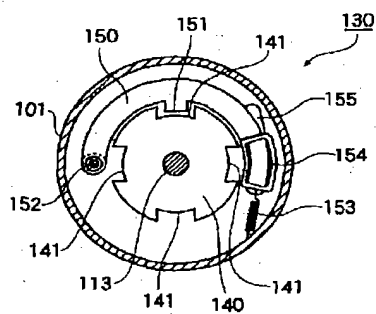
【0057】

【発明の効果】以上説明したように、各請求項にかかる車両用操舵制御装置によれば、ロック制御手段によって、駆動手段の動作制御に加え、モータの動作制御を行うので、ロック時には、回転部材の係止可能部と傾動部

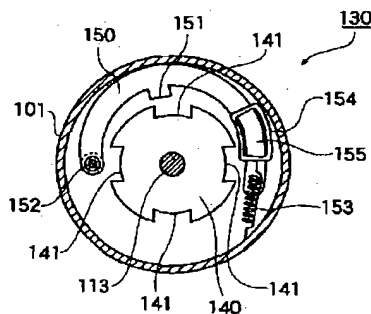
【図5】 伝達比の可変制御を示すフローチャートであ

150…ロックアーム（傾動部材）

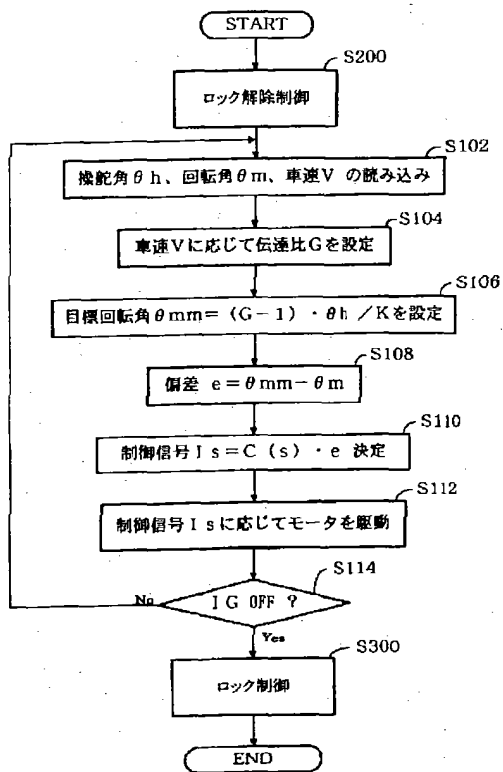
【图 3】



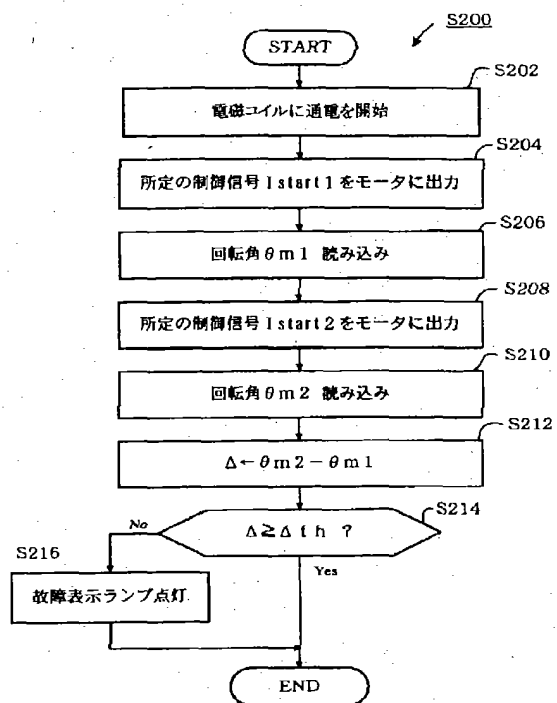
【图4】



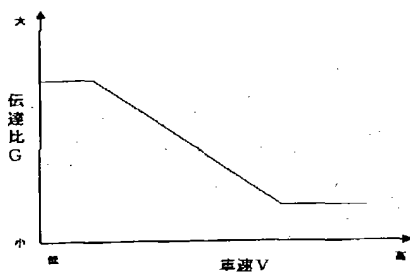
【図5】



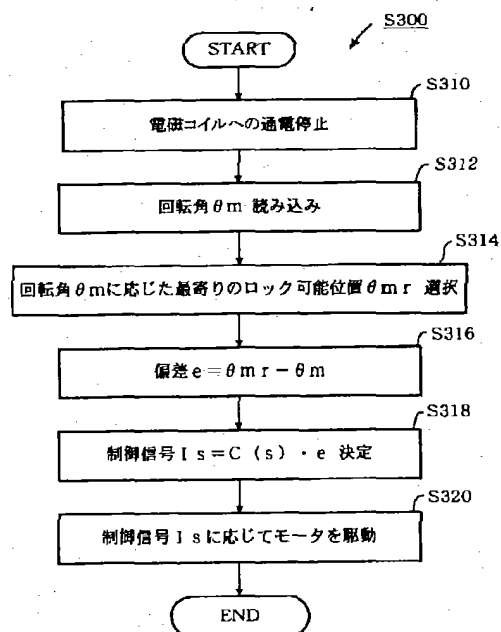
【図6】



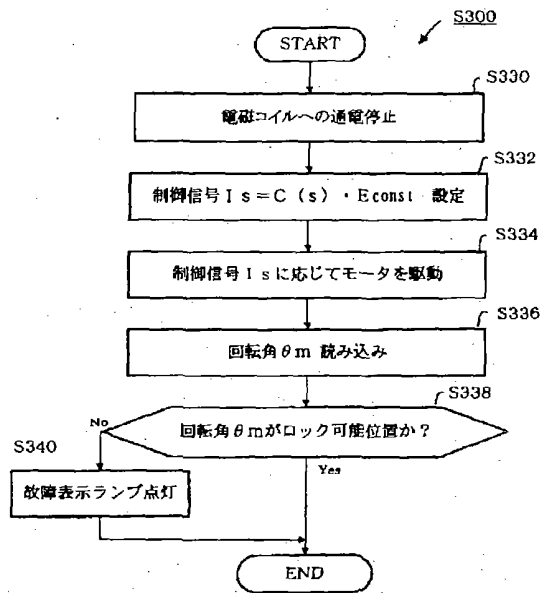
【図7】



【図8】



【図9】



フロントページの続き

(72) 発明者 松田 守弘
 愛知県豊田市トヨタ町1番地 トヨタ自動車株式会社内
 (72) 発明者 中津 慎利
 愛知県豊田市トヨタ町1番地 トヨタ自動車株式会社内

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